

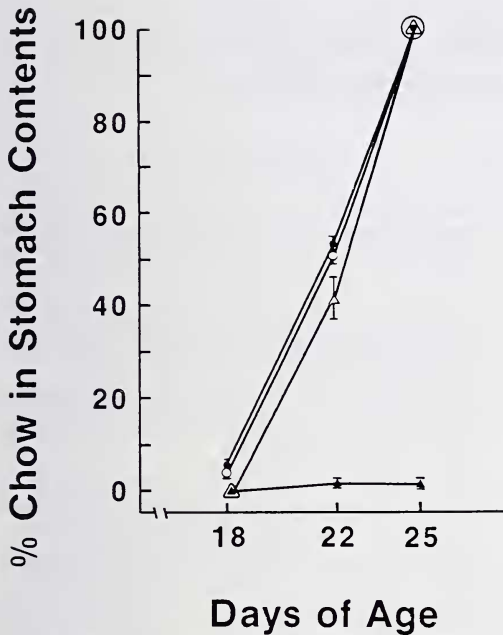


FIG. 2. Percent of total stomach contents as animal chow found in the same pups given the dietary preference test, after spending the night in the home cage with the natural dam. Circles: pups of euthyroid dam. Triangles: pups of thioracil-fed dams. Closed symbols: vehicle-injected pups. Open symbols: T₄-injected pups.

included the determination of rectal temperature and of incisor length because of the small size of mouse pups. In addition to those measurements made in rats, we included observations of the influence of administered T₄ on weaning of pups from euthyroid dams, and a determination of circulating T₄ levels at the end of the experiment. It was deemed necessary to include these aspects to ensure that the T₄ dosage of 50 ng/g body weight represented a physiological dose in mice as well as rats. Since T₄ injection of euthyroid pups did not significantly modify body weight gain or circulating T₄ levels (Table 1) and since weaning measures of these animals closely paralleled those of vehicle-injected littermates (Figs. 1 and 2), the dosage of exogenous T₄ was considered physiological. It is of interest that T₄ injection of 21 day old euthyroid pups was the only treatment to result in pups spending more time with non-maternal food choices at room temperature than at incubator

temperature. While the difference was not statistically significant, it may support a previously reported acceleration of locomotor development with T₄ augmentation in mice [11]. The appropriateness of this T₄ dosage was further supported by replacement injection at this level returning the growth rate of chemically hypothyroid mice to normal and significantly improving severely depressed circulating T₄ levels (Table 1).

As reported in rats [5], chemically-induced hypothyroidism severely retarded the normal progression of weaning in the present study, whether assessed by dietary preference test or by analysis of stomach contents. Indeed, the values reported here for percent time spent with a non-maternal food source during dietary preference testing (Fig. 1, C and D) are nearly identical, at each age and environmental temperature used to test chemically hypothyroid and hypothyroid T₄-injected mice, with those measurements made by Blake and Henning [5] in rats.

Investigators using the hamster to study the process of weaning have suggested important maternal influences upon its development [12]. Although there may be informational cues provided by the mother mouse as well, these do not seem to be the primary motivation to weaning since dietary preference of normal pups shifted with age to a greater proportion of non-maternal food choice, even though the maternal food source was an immobile anesthetized foster dam. Similar conclusions have been drawn using rats [5]. Furthermore, elevation of environmental temperature in an attempt to provide the pups with the body temperature normally maintained by the maternal sharing of body heat failed to normalize weaning in hypothyroid mice or to accelerate its progression to any great degree in normal mice.

Analysis of stomach contents found T₄ injection of hypothyroid pups to have no effect on the percent chow consumed at 18 days of age, but to return chow consumption toward normal at 22 days and completely to normal at 25 days when stomachs of treated pups contained chow alone as did those of normal mice (Fig. 2). This is an interesting finding in light of the dietary preference results which suggest that T₄-injected hypothyroid mice spent 45% of the test time with non-maternal

food at 24 days of age, whereas normal pups spent 92% of the test time away from the mother at the same age (Fig. 1, A and D). This apparent contradiction is likely to be the result of a combination of a number of factors including the following. The T_4 -injected pups may progress in weaning behavior from 24 to 25 days of age rapidly enough to demonstrate an obvious developmental spurt. Additionally, the dosage of thiouracil administered may be sufficient to inhibit conversion of some proportion of injected T_4 to triiodothyronine (T_3), the biologically active molecule [13]. Perhaps such a situation is more detrimental to normal development of locomotor and discriminatory behaviors, as evidenced by the dietary preference test, than to factors controlling actual consumption of chow. The latter suggestion is an attractive one since the concentration of goitrogenic material used in this and previous studies [5], which appears to prevent weaning, has been a relatively high one. Blake and Henning [6] have found relatively low doses of the propyl ester of thiouracil (PTU) to allow weaning to occur in rats, but with an approximate 3–5 day delay past normal. It would be of interest to determine whether high and low doses of goitrogen or genetic hypothyroidism [14] have differential effects on the liver deiodinase enzyme responsible for converting T_4 to T_3 , and whether such differences play a role in determining if a rat or mouse weans normally, weans late, or does not wean at all.

Taken together, the dietary preference tests and analyses of stomach content performed in the present study suggest that the influence of thyroid status on the weaning process in mice is very similar to that previously reported in rats [5] even though adult mice are much smaller and have a significantly higher metabolic rate than rats [7, 8]. Thyroid hormone appears to be required to allow normal progression of weaning from milk to chow, regardless of ambient temperature. Further studies of the importance of conversion of T_4 to T_3 for normal weaning in the mouse are planned.

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A Ghost Shrimp with Four-Articulate Fifth Pereopods (Crustacea: Caprellidea: Phtisicidae) from Northwest Australia

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ABSTRACT—*Quadrisegmentum triangulum* gen. et sp. nov. was found in a gorgonian host, *Isis hippurus*, on Ashmore Reef, Northwest Australia. The new genus is unique in the subfamily Phtisicinae in having four-articulate fifth pereopods. Genera having six-, five- and three-articulate fifth pereopods were previously known in this subfamily. Generic relationships within the Phtisicinae are discussed.

INTRODUCTION

The specimens reported herein were collected by H. K. Larson from a gorgonian host, *Isis hippurus* Linnaeus, on Ashmore Reef in Northwest Australia on 24 July 1986 and were sent to me for identification by A. J. Bruce. They are members of the subfamily Phtisicinae on the basis of the 3–4 fully segmented pereopods [1, 2] but do not fit any definition of the known genera in terms of the numbers of segments in pereopod 5. The new ghost shrimp is 4-articulate, while the known genera of this subfamily are 6-, 5- and 3-articulate [1–6]. These characters are important to the construction of a phylogeny in the subfamily Phtisicinae because they show successional changes in the segmentation of pereopod 5. The new ghost shrimp is described and generic relationships within the subfamily Phtisicinae are discussed on the basis of these characters and other generic ones.

All the specimens described herein are deposited in the collection of the Museum and Arts Galleries of the Northern Territory, Darwin, Australia.

Quadrisegmentum gen. nov.

Diagnosis

Flagellum of antenna 2, 7-articulate in male and

5-articulate in female. Mandibles lacking molar process, provided with 3-articulate palp. Inner and outer plates of maxilliped subequal in size. Gills present on pereonites 2–4, small. Pleonal appendages 2-paired, 2-articulate. Pereopods 3–4, 6-articulate; pereopod 5, 4-articulate.

Type species. *Quadrisegmentum triangulum* sp. nov.

Etymology. The generic name refers to the four-articulate fifth pereopods. The gender is neuter.

Remarks

The new genus apparently belongs to the subfamily Phtisicinae Vasilenko, 1968 [1, 2, 8] with the following diagnostic characters: Gills present on pereonites 2–4; mandibles lacking molar, furnished with 3-articulate palp; pereonites 3–4, 6-articulate. However, it may be clearly distinguished from other genera within this subfamily by unique segmentation of pereopod 5; it is 4-articulate in the new genus and 6-, 5- and 3-articulate in the known genera.

Within the subfamily Phtisicinae, two-paired and bi-articulate pleonal appendages suggest that the new genus is related to six genera: *Paraproto* Mayer, 1903 [3], *Pseudoprotomima* McCain, 1969 [5], *Phtisica* Slabber, 1769 [3, 4, 8], *Protomima* Mayer, 1903 [3, 7], *Protoplesius* Mayer, 1903 [3] and *Chaka* Criffiths, 1974 [6]. All these genera, including *Quadrisegmentum* gen. nov., can be divided into four groups based on the segmentation

of pereopod 5: 1) 6-articulate group (*Paraproto*, *Pseudoprotomima*), 2) 5-articulate group (*Phtisica*, *Protomima*, *Protoplesius*), 3) 4-articulate group (*Quadrisegmentum* gen. nov.) and 4) 3-articulate group (*Chaka*). These groups suggest an evolutionary change in the phylogeny of the subfamily Phtisicinae, i.e., the 6-articulate fifth pereopods evolved to 3-articulate through 5-articulate and 4-articulate fifth pereopods. Other generic characters listed to date [1-8] do not indicate successional or phylogenic relationships within this subfamily. For example, the setal formula on the terminal segment of the mandibular palp is 1-x-1, where x indicates the number of short setae held between longer setae at both ends of a setal row. The x, however, shows irregular variations at the generic and specific levels [3-8]. Further, the segmentation number of the flagellum of antenna 2 is irregularly variable in the six genera: 14-articulate (males) and 10-articulate (female) in *Paraproto*, 7-articulate (males) and 5-articulate (females) in *Quadrisegmentum* gen. nov., 2 to 5-articulate in *Phtisica*, 2-articulate (males) and 5-articulate (females) in *Protoplesius*, 4-articulate in *Pseudoproto* and *Protomima*, and 3-articulate in *Chaka*. Although the evolutionary tendency of the flagellum segmentation generally shows a reduction in the caprellid amphipods [4, 7, 8], this phenomenon can not be observed in the subfamily Phtisicinae. Therefore, I present the phylogenic assumption that the genera in the sub-

family Phtisicinae have evolved from the group with the 6-articulate fifth pereopods to the group with the 3-articulate ones through the groups with 5- and 4-articulate fifth pereopods and that the new genus *Quadrisegmentum* is at an intermediate state on the evolutionary line.

Quadrisegmentum triangulum sp. nov.
(Figs. 1-3)

Description of the male holotype (8.0 mm)

Body Not spinose. Length ratios of pereonites 1-7, 3:4:5:6:9:8:2. Gills present on pereonites 2-4, small. Pleonal appendages 2-paired, 2-articulate, serrate on inner margins.

Antennae Antenna 1: Length ratios of peduncular segments 1-3, 3:4:5; flagellum 10-articulate, each segment furnished with 1 aesthetasc. Antenna 2: Gland cone of peduncular segment 2 distinct; length ratios of peduncular segments 3-5, 1:3:3; flagellum consisting of 7 segments, distal one rudimentary.

Mouthparts Upper lip symmetrically bilobate. Lower lip: Mandibular process medium. Maxilla 1: Outer plate provided with 6 tooth-like spines; palp consisting of 2 segments, distal one provided with 4 teeth, 1 apical spine and 3 setae on distal half of outer side. Maxilla 2: Both plates provided with 5 apical setae. Mandibles similar to each other; incisor provided with 4 large teeth; lacinia

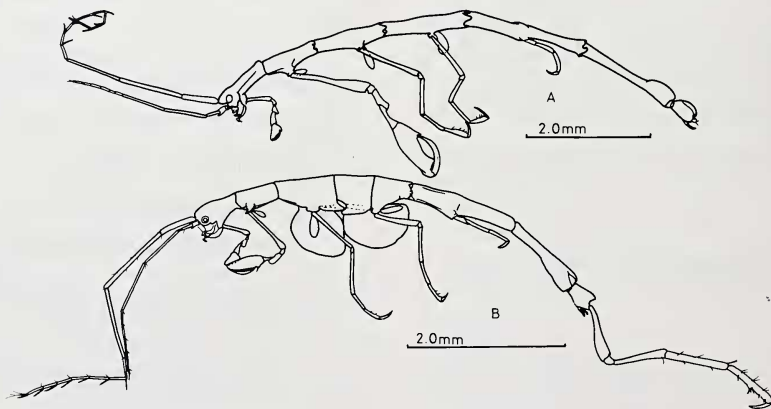


FIG. 1. *Quadrisegmentum triangulum* gen. et sp. nov. A: Holotype, male, 8.0 mm. B: Paratype (no. 2), female, 5.2 mm.

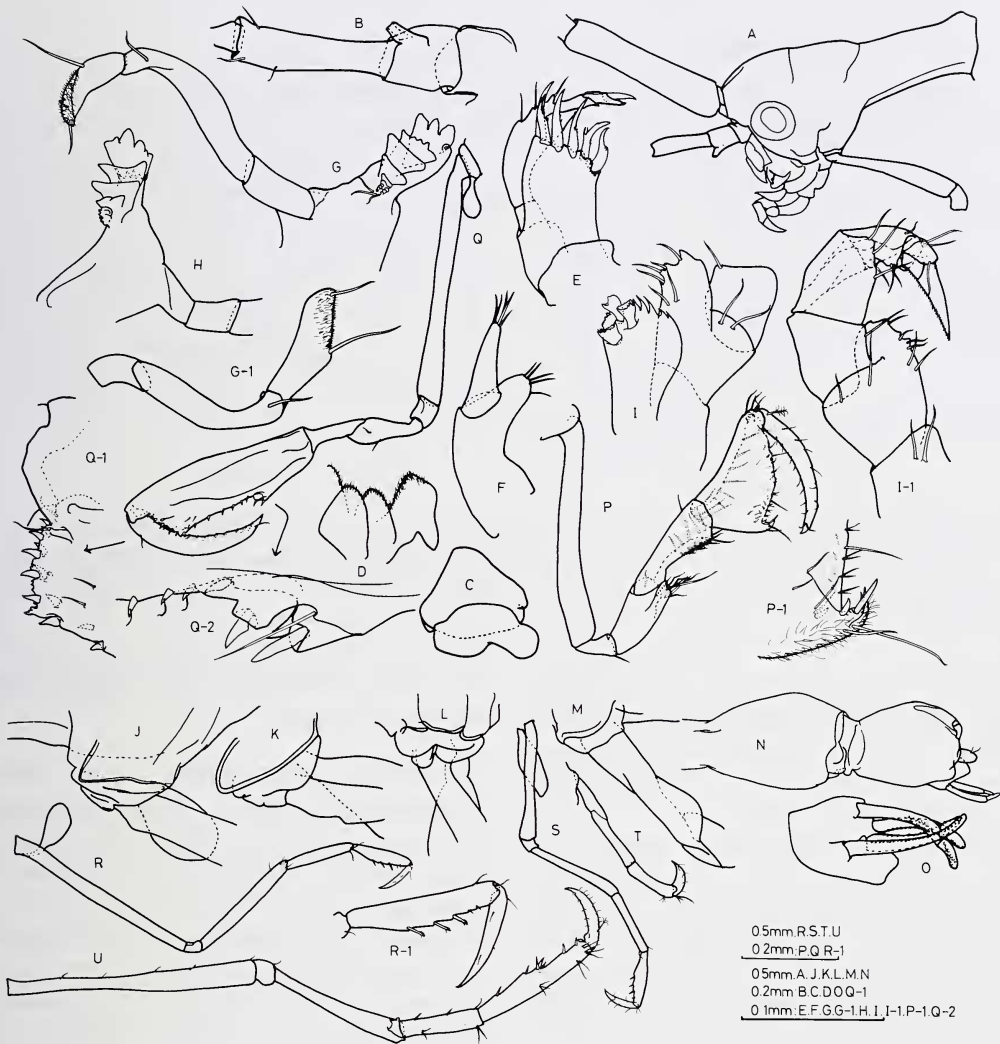


FIG. 2. *Quadrisegmentum triangulum* gen. et sp. nov., male holotype. A: Head. B: Peduncle of antenna 2. C: Upper lip. D: Lower lip. E: Maxilla 1. F: Maxilla 2. G: Left mandible. G-1: Palp of left mandible. H: Right mandible. I: Inner and outer plates of maxilliped. I-1: Outer plate and palp of maxilliped. J: Coxa 2. K: Coxa 3. L: Coxa 4. M: Coxa 5. N: Pereonites 6-7. O: Pleonal appendages. P: Gnathopod 1. P-1: Palmar cusp of gnathopod 1. Q: Gnathopod 2. Q-1 and Q-2: Palm of gnathopod 2. R: Pereopod 3. R-1: Propod and dactyl of pereopod 3. S: Pereopod 4. T: Pereopod 5. U: Pereopod 6.

mobilis consisting of 3 large and several small plates; accessory setae 3 in number; palp consisting of 3 segments, of which middle one is furnished with 1 distal seta, terminal segment of palp pubescent and bearing 2 setae on distal half. Maxilliped: Inner plate serrate distally, armed with 3 apically serrate spines; outer plate subequal to inner plate in size, provided with 6 inner marginal setae; palp

consisting of 4 segments, of which the penultimate one is prominently protruded distolaterally.

Coxae Coxae 1-5 coalescent with pereonites, vestigial; coxae 6-7 absent.

Gnathopods 1-2 Gnathopod 1: Length ratios of segments from basis to propod approximately 16:3:7:9:10; carpus compressed at 1/3 from proximal end; propod triangular; palm defined by

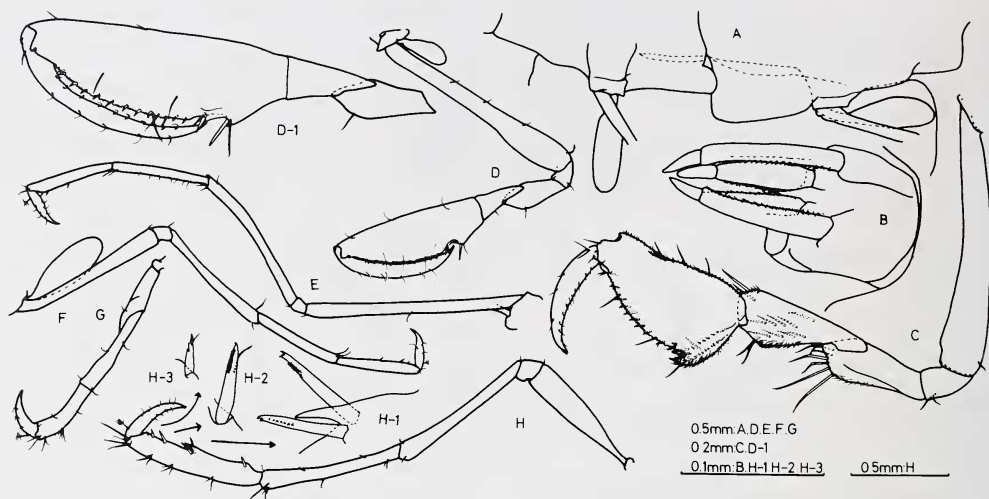


FIG. 3. *Quadrisegmentum triangulum* gen. et sp. nov., female paratype (no. 2). A: Ventrolateral part of pleonites 3-4. B: Pleonal appendages. C: Gnathopod 1. D: Gnathopod 2. D-1: Merus, Carpus, propod and dactyl of gnathopod 2. E: Pereopod 3. F: Pereopod 4. G: Pereopod 5. H: Pereopod 7. H-1, H-2 and H-3: Spines on propod of pereopod 7.

prominent, curved, bifid process with 2 accompanying spines; dactyl reaching cusp when closed. Gnathopod 2 slender, feeble on segments from basis to carpus; length ratios of segments from basis to propod approximately 9:1:3:2:7; merus and carpus not prominently overlapping each other; propod quadrangular; palm extending on more than half of posterior margin of propod, truncate and serrate distally, defined by both palmar and poison projections, each of them armed with 1 spine; dactyl reaching palmar protrusion when closed, provided with numerous pits on grasping margin.

Pereopods 3-7 Pereopods 3-4: 6-articulate, slender, feeble; pereopod 3, 0.78 as long as pereopod 4; length ratios of segments from basis to dactyl approximately 9:1:7:5:4:3 in pereopod 3, 15:1:9:5:5:3 in pereopod 4; propod slightly dilated at 3/7 from proximal end, bearing 4 spines on distal 4/7 of inner margin, distal spine of them small. Pereopod 5: 4-articulate, slender; length ratios of segments 1-4, 4:5:4:2; propod uniform in width; dactyl falcate. Pereopod 6: 6-articulate, slender; length ratios of segments from basis to dactyl approximately 14:1:7:4:7:3; propod provided with inner medial tooth bearing 2 paired spines basally, also with 4 inner spines in addition

to these two paired spines; dactyl falcate. Pereopod 7 missing.

Description of female paratype (no. 2, 5.2 mm)

Antenna 2: Flagellum consisting of 4 segments and a rudimentary one. Gnathopod 1 similar to that of female. Gnathopod 2: Length ratios of segments from basis to propod 16:2:5:4:11; merus and carpus obliquely articulate; segmentation scar visible between carpus and propod; propod semilunar; palm defined by palmar protrusion, which is armed with 1 spine, slightly rounded, finely serrate from proximal 2/3 point to distal end of itself; poison tooth present near palmar spine, armed with 2 paired spines; dactyl reaching poison tooth when closed. Pereopods 3-4: Propod not dilated, provided with 3 small spines; dactyl slightly dilated proximally. Pereopod 5 similar to that of male. Pereopod 6 missing. Pereopod 7: Merus, carpus and propod equal in length, slightly longer than basis; carpus provided with 2 spines; propod with 1 medial tooth bearing 2 paired spines basally, also with 1 proximal and 2 distal spines; dactyl falcate, reaching opposite proposal tooth when closed.